V. *On the classification of some families of the* Tineina.

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Contrary to my preconceived opinion I have satisfied myself that the family classification of the Lepidoptera, as at present existing, is in the main wholly unsatisfactory. Based as it is entirely upon European types, its deficiencies only become readily apparent when it is attempted to apply the scheme to the fauna of a distinct region. One discovers then how vague and ill-defined the principal families are; the newly-added species destroy all remaining semblance of distinction, and the conclusion is inevitable, that without the aid of a system founded on well-marked and definite characters, the whole science will speedily become involved in hopeless confusion.

Two causes have principally contributed to this result, over and above the narrowness of the field of research, *viz.*, over-reliance on superficial characters, and underestimation of the value of neuration. As a striking instance of the former, take the group of the *Tortricina*, the classification of which, as at present understood in England, is scientifically quite worthless. The group presents a remarkably small range of variation in the superficial characters of form, marking, and colour, and consequently the same general appearance frequently recurs in distinct genera, and especially frequently in allied genera. Structure has consequently been disregarded in the attempt to bring together discordant species, and has even come to be more or less despised as an untrustworthy indication of affinity. Yet the group, which has been considered one of great difficulty (as indeed any group is, if classified on such principles), is really one of the easiest to arrange on a natural system. I have elsewhere (Proc. Linn. Soc. of New South Wales, 1881) given in full my views on the classification of this group, to which I need not further allude

now, except to remark that it is accurately separable into three sharply-marked families.

Neuration has probably been neglected, as being less easily observed than other characters. Yet, when one has become tolerably familiar with the principal types and deviations of structure, it can almost always be readily discerned by an examination of the under surface of the wings, where the veins usually stand out more prominently. In cases of special difficulty the wing may be rendered momentarily transparent with benzine, but the cilia are sometimes injured in this way. In the *Tortricina* and larger *Tineina* the veins can almost invariably be made out without much trouble.

The neuration forms, in my opinion, the most reliable guide to the classification of the Lepidoptera. In examining large numbers of new species I have been greatly struck by the persistence of its character in particular groups, even when the form of the wings undergoes extreme modifications. I do not mean to affirm that differences of neuration are always of importance; *Cerostoma*, Lat., and *Blabophanes*, Z., may be instanced as displaying considerable variation in this respect within genera undoubtedly natural; yet even here the variation is confined to certain limits, and *Blabophanes*, though hardly two species are identical in neuration, is yet absolutely separable from all its allies by neural characters alone. But in 450 Australian *Œcophoridæ* I found the type of neuration absolutely identical throughout, and in general I have assured myself that it affords a means of defining accurately the natural families of the *Tineina*, and probably the whole of the Lepidoptera. In the Proc. Linn. Soc. of New South Wales for this year I have pointed out how well it serves to define the natural, yet hitherto practically uncharacterised, genera of the *Crambidæ*. And in the present paper I have endeavoured to set forth the conclusions to which I have been led in the investigation of a principal group of the *Tineina*; by the result of which I desire that the principles involved may be estimated.

It should be kept in mind that, when a group has been defined by considerations of structure alone, if such a group is found to be locally distributed so as to be confined to or excluded from one or more zoological regions, the argument for its naturalness is very greatly

strengthened, and the case may in general be considered proved without special reason to the contrary. This follows immediately from the first principles of evolution.

In the following results I consider the families to be of the same value biologically as the natural orders of plants. I have been obliged to rely mainly on European and Australian species in forming the classification, since those of other regions, though partly known, have been generically too ill characterised to be available for evidence; but I have included such other exotic genera as it was possible to locate with tolerable certainty. Even Zeller's descriptions of exotic genera are commonly unrecognisable and impracticable when the neuration is not given. The neural terminology here employed is that used by von Heinemann and commonly on the Continent, the veins being denoted by numbers, counting from the inner margin to the costa.

The genera here classified are almost all included by von Heinemann in his heterogeneous family of the *Gelechiidæ*, and by Stainton in his *Gelechiidæ* and *Œcophoridæ*. Neither of these families, as understood by their authors, admits of definite characterisation, and they are therefore practically useless; and the number of species included is so enormous that, unless united by the possession of very definite characters, they would imperatively call for further subdivision. They do, however, form a connected group, standing at the head of the *Tineina*, and conforming to a single type. The essential characters of this type are:—fore wings with 12 veins, 7 and 8 stalked; hind wings with 8 veins; labial palpi recurved, pointed. The exceptions to any of these characters are very few, and are specified below in their proper place; but the characters are insufficient for definition, since they recur in combination in the *Plutellidæ*, *Hyponomeutidæ*, and *Elachistidæ*, though only occasionally. One character deserves very especial attention, *viz.*, the stalking of veins 7 and 8 of the fore wings; to this there is no exception whatever, the only appearance of one being in the two genera of *Œcophoridæ*, where these veins coincide throughout instead of partially, and in the two genera of *Gelechiidæ*, where vein 5 is absent, and therefore the stalked veins are 6 and 7 in actual order of numbering.

I propose a division of these genera into six families, as follows :—

GELECHIIDÆ.

Antennæ simple (very rarely ciliated in male). Fore wings with 12 veins (rarely 11 or 10 by obsolescence of veins 5 and 10), 7 and 8 stalked, 7 to costa (rarely to hind margin), 2 from or near angle of cell. Hind wings with 8 veins (rarely 7 by obsolescence of vein 5), 3 and 4 separate or from a point or stalked, 6 and 7 stalked or separate. Hind wings often much broader than fore wings, or sharply emarginate beneath the produced apex.

A very large family, containing in Europe about 450 species, and I have 120 from Australia and New Zealand; it appears cosmopolitan, and is everywhere largely represented, but is less conspicuous in the southern hemisphere than in the northern. The following is an attempted arrangement of the European genera, though the subdivisions given are perhaps not accurately definable :—

A. Vein 7 of fore wings to costa.

a. Veins 3 and 4 of hind wings separate.

Œcocecis, *Gn.*
Chilopselaphus, *Mn.*
*Megacraspedus, *Z.*
Mesophleps, *H-S.*
Cleodora, *Curt.*
Ceuthomadarus, *Mn.*
Anarsia, *Z.*
Psoricoptera, *Stt.*
Chelaria, *Hw.*
Parasia, *Dup.*
Rhinosia, *Tr.*
Stomopteryx, *Hein.*
Ptocheuusa, *Hein.*
*Sitotroga, *Hein.*
Apodia, *Hein.*
Recurvaria, *H-S.*
Anacampsis, *Curt.*
Argyritis, *Hein.*
Pœcilia, *Hein.*
Nannodia, *Hein.*
Lamprotes, *Hein.*
Monochroa, *Hein.*
Doryphora, *Hein.*
Ergatis, *Hein.*

b. Veins 3 and 4 of hind wings from a point or stalked.

Teleia, *Hein.*
*Lita, *Tr.*
Bryotropha, *Hein.*
Brachmia, *Hein.*
*Gelechia, *Z.*
Acanthophila, *Hein.*
Tachyptilia, *Hein.*
Brachycrossata, *Hein.*
Ceratophora, *Hein.*
Cladodes, *Hein.*

Sophronia, *Hb.*	*Ypsolophus, *F.*
Holcophora, *Stgr.*	Apiletria, *Ld.*
Nothris, *Hb.*	Lecithocera, *H-S.*

B. Vein 7 of fore wings to hind margin.

Euteles, *Hein.*	Symmoca, *Hb.*
Gonia, *Hein.*	

To this family belong also the following exotic genera, according to the characters given for them, but I cannot locate them more definitely :—

Anorthosia, *Clem.*	*Strobisia, *Clem.*
Evagora, *Clem.*	Clistothyris, *Z.*
Trypanisma, *Clem.*	Trichotaphe, *Clem.*
Enchrysa, *Z.*	Epicorthylis, *Z.*

Those genera marked (*) occur also in Australia, but of these *Sitotroga* has doubtless been introduced ; I suspect this genus to be not native even in Europe, but imported from America. I have about fifteen additional Australian genera.

CHIMABACCHIDÆ.

Antennæ ciliated in male (or rarely simple ?). Fore wings with 12 veins, 7 and 8 stalked, 7 to hind margin, 2 from rather before posterior angle of cell. Hind wings with 8 veins, 3 and 4 separate at origin, 6 and 7 separate, nearly parallel. Hind wings not or slightly broader than fore wings, hind margin rounded or slightly sinuate.

A small European group, not hitherto identified elsewhere.

Dasystoma, *Curt.*	Semioscopis, *Hb.*
Chimabacche, *Z.*	Exæretia, *Stt.*

DEPRESSARIIDÆ.

Antennæ simple. Fore wings with 12 veins, 7 and 8 stalked, 7 to costa or apex (rarely to hind margin), 2 from or near angle of cell. Hind wings with 8 veins, 3 and 4 from a point or stalked, 6 and 7 separate, nearly parallel. Hind wings not broader than fore wings, hind margin rounded.

A moderately extensive family, represented in Europe by about 110 species, nearly all belonging to *Depressaria*, which genus is little known elsewhere. From Australia and New Zealand I have only about 12 species, but the group appears to be fairly numerous in North and South America, and is said (probably correctly) to occur also in India and South Africa. The European genera are :—

Epigraphia, *Stph.*	Phibalocera, *Stph.*
Depressaria, *Hw.*	Enicostoma, *Stph.*

The following exotic genera are also referable to this family :—

Loxotoma, *Z.*	Agriocoma, *Z.*
Machimia, *Clem.*	Peleopoda, *Z.*
Psilocorsis, *Clem.*	

Of these *Loxotoma* alone occurs in Australia, where are three or four other genera ; there is also one in New Zealand.

CRYPTOLECHIIDÆ.

Antennæ ciliated in male. Fore wings with 12 veins, 7 and 8 stalked, 7 to hind margin (rarely to costa), vein 2 from before posterior fourth of lower margin of cell, widely remote from 3. Hind wings with 8 veins, 3 and 4 from a point or stalked, 6 and 7 stalked or closely approximated at base. Hind wings not broader or rather broader than fore wings, hind margin sinuate.

Extensively represented in South America, and less numerously in South Africa and Australia, but practically absent from the European region, which only possesses one species. Much confusion exists at present, owing to Zeller having included in his original genus *Cryptolechia* species not only of this family, but also of the *Œcophoridæ*, and perhaps *Depressariidæ*, which are perfectly distinct. From Australia I have about 80 species, but the family is absent from New Zealand, except one probably not indigenous species. All the Australian insects described by Zeller under *Cryptolechia*, however, belong to the *Œcophoridæ*.

The described genera certainly belonging here are—

Cryptophasa, *Lw.*	Antæotricha, *Z.*
Cryptolechia, *Z.*	

All these occur in Australia, to which region *Cryptophasa* is confined, and there are five or six new Australian genera. South America appears specially rich in this family and probably contains many additional genera.

ŒCOPHORIDÆ.

Antennæ ciliated in male. Fore wings with 12 veins (rarely 11 by coalescence of 7 and 8), 7 and 8 stalked, 7 to hind margin, apex, or costa, 2 from or near angle of cell. Hind wings with 8 veins, 3 and 4 from a point (rarely stalked), 6 and 7 separate, nearly parallel. Hind wings not broader than fore wings (very rarely slightly broader), hind margin rounded or slightly sinuate.

Rather largely represented in Europe, and extremely abundant in Australia and New Zealand, where it is the principal family of the Lepidoptera; little recorded from elsewhere, but certainly occurring in India and North and South America. The European species number about 100; from Australia and New Zealand I have 450, and the entire number inhabiting that region probably exceeds 2000.

The following is a classification of the European genera, including the only described exotic genus certainly referable :—

A. Vein 7 of fore wings to hind margin or apex.

Anchinia, *Hb.*	Aplota, *Stph.*
Cacochroa, *Hein.*	Protasis, *H-S.*
Hypercallia, *Stph.*	Topeutis, *Hb.*
*Peltophora, *Meyr.*	*Pleurota, *Hb.*
Holoscolia, *Z.*	Hypatima, *H-S.*

B. Vein 7 of fore wings to costa.

Gonionota, *Z.*	Harpella, *Schrk.*
Psecadia, *Hb.*	*Œcophora, *Z.*

To the Australian genus *Peltophora* belongs *forficella*, Sc., hitherto erroneously included in *Harpella*. The three genera marked (*) are all freely represented in Australia, whence (including New Zealand) I have characterised also 67 new genera, now being published in the Proc. Linn. Soc. of New South Wales. I have included the South American *Gonionota*, though imperfectly characterised, because it is evidently so nearly

allied to a New Zealand genus that there can be little doubt of its position.

Of the unity of this family I have no doubt; the Australian species traverse the whole range of the genera given above, and extend considerably beyond them, whilst still preserving their family characters with an extraordinary persistency.

DASYCERIDÆ.

Antennæ thickened with dense scales, ciliated in male. Fore wings with 12 veins, 7 and 8 stalked, 7 to costa, 2 from or near angle of cell. Hind wings with 8 veins, 3 and 4 from a point, 6 and 7 separate or from a point. Hind wings not broader than fore wings, hind margin rounded.

A small but peculiar family, not capable of being incorporated with any other; widely distributed, occurring in Europe, North America, India, South Africa, and Australia. Some species have the singular habit of carrying the posterior legs erect above the back, as in some genera of *Elachistidæ*, but it is certain that the similarity of habit does not here indicate affinity. About fifteen species are known altogether. The described genera are:—

Dasycera, *Hw.* Atkinsonia, *Stt.*
Eretmocera, *Z.*

Of these *Dasycera* occurs in Europe and North America, *Eretmocera* in South Africa and Australia, and *Atkinsonia* in India and Australia.

These six families constitute the group above mentioned. In connection with them may also be noticed a seventh, which, although separated from the main group by having veins 7 and 8 of the fore wings commonly separate, is yet in other respects nearly allied to them, especially to the *Œcophoridæ*.

GLYPHIPTERYGIDÆ

Antennæ simple or ciliated in male. Fore wings with 12 veins (rarely 11 by coalescence of 7 and 8), 7 and 8 separate or rarely stalked, 7 to hind margin, 2 from near angle of cell, 1 simple at base or sometimes furcate. Hind wings with 8 veins, 3 and 4 from a point, 6 and 7

separate, parallel. Hind wings not broader (rarely somewhat broader) than fore wings, hind margin rounded.

The family is universally distributed, but not very numerously represented anywhere, being apparently most plentiful in the Australian region. The following is a classification of all the genera :—

Hilarographa, *Z.*	Simaethis, *Leach.*
Choregia, *Z.*	Choreutis, *Hb.*
Hypertropha, *Meyr.*	Millieria, *Rag.*
Eupselia, *Meyr.*	Glyphipteryx, *Z.*
Æolocosma, *Meyr.*	Apistomorpha, *Meyr.*
Brenthia, *Clem.*	Phryganostola, *Meyr.*

Of the other genera included under the *Gelechiidæ* in Staudinger's Catalogue, *Carposina*, H-S., belongs to the *Conchylidæ*, as I have elsewhere pointed out. *Blastobasis*, Z., is in no way nearly related here, but belongs to the neighbourhood of the *Hyponomeutidæ*. Of *Metanarsia*, Stgr., *Pterolonche*, Z., *Atremæa*, Stgr., *Epidola*, Stgr., and *Alloclita*, Stgr., I have not sufficient evidence to fix the position, but they probably all belong to one or other of the six families above enumerated. It will be apparent also that von Heinemann and Wocke were right in removing from this group *Butalis*, Tr., *Pancalia*, Curt., *Endrosis*, Hb., and their allies.

The following exotic genera are probably also referable to these families, but I am not able to determine their position for want of detail :—

Dysgnorima, *Z.*	Falculina, *Z.*
Auxocrossa, *Z.*	Chrysopora, *Clem.*
Mesoptycha, *Z.*	Helcystogramma, *Z.*
Mixogenes, *Z.*	Copocercia, *Z.*
Menesta, *Clem.*	Teratopsis, *Wals.*

Four other genera,—*Hermogenes*, Z., *Meridarchis*, Z., *Dasycarca*, Z., and *Ecliptoloma*, Z.,—have also been referred to the *Gelechiidæ*; but if the incomplete particulars given of their neuration are correct, they can have no true affinity here.

For the practical application of the family characters given above, it must be observed that any two families are not, as a rule, separated by the presence or absence of a single character. Most commonly they are distinguished by at least three points, to each of which rare

exceptions occur, doubtful cases being decided by majority of characters. When, however, they are distinguished by a single point (as, for example, the *Depressariidæ* and *Œcophoridæ* differ by the presence or absence of ciliations of the antennæ of the male), this character admits of no exception. It will be apparent that this is in accordance with what might be expected to result from the natural formation of families; for supposing, by variation of a particular character and extinction of intermediate forms, a new and distinct family type to be brought into being, there will be no reason whatever why the new family should not exceptionally, whether by reversion or independent variation, develop again solitary instances of the special character of its parent family. If it does this to any considerable extent the family can no longer be maintained; but if it does it in rare instances only, and at the same time continues to diverge also in other respects, it is probable that by a consideration of all points combined there will be no difficulty in detecting the true position of any particular genus, and such real or apparent reversion to any ancestral type need not be taken to vitiate the genuine distinctness of the family.

It remains to sketch the probable process of development of the group, according to this scheme of classification. The origin of the whole is to be sought in the *Œcophoridæ*, which represent the simplest type, themselves originating in the Butalid group of the *Elachistidæ* (the classification of which, whether as one or more families, need not here concern us). In accordance with this hypothesis, we find the *Œcophoridæ* at their maximum of development in the Australian region, which from its isolation has always tended to preserve such primitive forms from the disastrous competition of superior types; whilst in other regions they have been in great part (but nowhere entirely) supplanted by later developments. The *Œcophoridæ* were early divided into two natural groups (above distinguished as A and B), in the former of which vein 7 of the fore wings terminates in the hind margin or apex, and in the latter in the costa. From group B rose the *Depressariidæ*, differing by the loss of the characteristic ciliations of the antennæ, and originating from near *Psecadia*. From the same group came also the *Dasyceridæ*, a small but ancient development from near *Œcophora*. The *Glyphipterygidæ*

would appear to be also a very ancient group, probably proceeding from group A of the *Œcophoridæ*, and reverting in some points to an older type; on which view *Eupselia* and *Æolocosma* might be regarded as approaching the primitive types of the family, and *Glyphipteryx* itself as being one of the most specialised forms. The *Chimabacchidæ* are developed immediately from the *Depressariidæ*, the characteristic change being in the separation of veins 3 and 4 of the hind wings. It is this family which gives rise to the whole group of the *Tortricina*, producing a generalised type from which the three families of the *Tortricina* rise simultaneously in diverging lines. Except the *Tortricina*, no further developments are known to have originated in any of the families of this group.

The origin of the two remaining families is not so clear as that of the others, and additional knowledge might lead me to modify my present conclusions, but I am disposed to think that the *Cryptolechiidæ* sprang from group A of the *Œcophoridæ*, preserving the characteristic ciliations of the antennæ, and the hind marginal termination of vein 7 of the fore wings, but deviating in the close approximation or coalescence at base of veins 6 and 7 of the hind wings, and the curious remoteness of vein 2 from the angle of the cell in the fore wings, the latter character analogous to what is found in two families of *Tortricina*. The *Gelechiidæ* seem to have originated from the *Depressariidæ*, diverging from them gradually in form and neuration of the hind wings, in which character they display great variability. They may be regarded as the most highly specialised family of all, the extreme of development being reached in the very narrow-winged genera with excessively emarginate hind wings; and they form, in most parts of the world, a dominant group.

On this view of the development of the group, the geographical distribution of the *Cryptolechiidæ* becomes highly interesting and important. The fact that the European region (comprising as well Northern and Western Asia and Northern Africa) is absolutely deficient in this family (for the single species, even if correctly referred here, for which I cannot vouch, can only be regarded as an exotic straggler) appears to be conclusive proof that they must have originated elsewhere; for it does not seem conceivable that a whole family, well

suited to many situations of the region, and found elsewhere flourishing in full competition with all European families, should have been ever wholly expelled from it in the struggle for existence. But it is both intelligible and likely that the same family might be unable to gain a footing from outside in the European region, stocked as it is with the most highly improved forms and protected by natural barriers. As a matter of fact the *Cryptolechiidæ* are found to be very plentiful in South America, and less plentiful, but still well represented, in South Africa and Australia. Probably they extend upwards into India and the Malay Archipelago, and perhaps also into North America, but they are absent from New Zealand. Now, assuming (what appears to me certain) that the family has never existed in Europe, the only other possible supposition is that there must have been at some period land-connection between the three southern continents. In confirmation of their southern origin, it is to be observed that the particular group, from which the *Cryptolechiidæ* appear to have been developed, is still and must always have been the prominent group in Australia. I am certainly of opinion that this case, relating to the whole of an extensive family, can be explained on no other hypothesis. It should be borne in mind that Wallace's well-known conclusions on this subject, drawn practically from the distribution of mammals and birds only, must (as I am reminded by Prof. Hutton) bear only on Tertiary and late Secondary times, and be therefore wholly inadequate to explain the distribution of so ancient a group as that of insects.

Of the other families, I believe the *Glyphipterygidæ* and *Dasyceridæ* to be very possibly of southern origin, but very early developed, and once co-extensive with the parent family *Œcophoridæ*; and the *Gelechiidæ*, *Depressariidæ*, and *Chimabacchidæ* to have been certainly developed in Europe, and thence spread over their present range.

When we consider the ancient origin, the small size, the fragility and defencelessness, the very limited specific range, and the scanty locomotive powers of the Micro-Lepidoptera, as well as their inaptitude for dissemination by extrinsic means, it appears to me that the study of their geographical distribution will be of unsurpassed value in determining the past history of the world. But before attempting this it is absolutely necessary that

their classification should be firmly established on solid principles. It is impossible to condemn too strongly the worthless character of the work done by those who create new genera at random, locate species by their superficial appearance, making a mere pretence of structural diagnosis, and frequently refer specimens of the same species to different genera, and even to different families, on account of slight differences in colour and shape of wing. It can hardly be expected that scientific investigators of the present day will acquiesce in the methods and results of writers who still continue to classify on the lines of Francis Walker. I am disposed to think that since, at the present time, a specific description is not only worthless, but also practically unidentifiable, unless accompanied by a full statement of the true generic characters, it may and should be as justly disregarded as though it were non-existent.